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THE NORTH AMERICAN SPECIES OF *PSYLLA* FROM WILLOW, WITH DESCRIPTIONS OF NEW SPECIES AND NOTES ON BIOLOGY^{1,2} (HOMOPTERA: PSYLLIDAE)

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THE PSYLLIDAE are relatively very specific in their selection of host plants, a host plant being defined as one on which they oviposit and complete their nymphal development. Most species do not have, as their hosts, plants in more than one genus. *Paratrioza cockerelli* (Sulc) is one of the rare exceptions. It is reported to breed on plants in three genera. All of its hosts are, however, in the family Solanaceae.

In North America the host plants of most species have been unknown. The host records which do exist are based primarily on the collection of adults on the respective plants. In many cases the presence on a plant of adults in large numbers is good circumstantial evidence of host relationship. In other instances it is not. During the adult stage, psyllids frequently disperse from the breeding hosts and may survive for extended periods of time on other plants. For example, early records of *Psylla americana* Crawford were from *Pinus* spp. upon which this species sometimes congregates during part of the year. Its true host, however, is willow.

Species in the genus *Psylla* in North America have been recorded primarily from the following plant genera: *Alnus*, *Prunus*, *Cercocarpus*, *Corylus*, *Carpinus*, *Purshia*, *Betula*, *Elaeagnus*, *Shepherdia*, *Buxus*, *Larrea*, *Phoradendron*, *Negundo*, *Ribes*, *Acer*, *Pyrus*, *Sorbus*, and *Salix*. Not all of these plants have been proved to be the breeding hosts of the psyllids in question, but the collections have involved such numbers and with such consistency that, with the possible exception of *Larrea*, they will in time probably be confirmed as hosts of the nymphs.

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The species of *Psylla* which breed on a given host genus typically exhibit rather marked similarity in general body coloration, size and structure. It is probable in many of these cases that the species as we now know them descended from a single species which originally became established on the plant genus in question.

On the basis of the present study, *Salix* serves as the host for more species of *Psylla* than any other plant genus in North America. (The *Salix*-inhabiting species in the genus *Trioza* are also relatively numerous.) This is due to one or more of the following reasons, given in the order of their probable importance: 1) the genus *Psylla* on willow appears to be so constituted genetically that speciation is progressing rapidly and can utilize the diverse biogeographical opportunities supplied by *Salix*; 2) willows are numerous and widespread throughout all of North America wherever fresh water occurs; 3) greater speciation has occurred within the genus *Salix* than in the other hosts listed. *Ribes* is probably its nearest rival in distribution and speciation. Speciation among the psyllids on this host, however, has been relatively meager. In contrast, *Cercocarpus* (mountain mahogany) which has a relatively restricted distribution and few species is next to *Salix* in the number of *Psylla* species which live on it.

It is the purpose of this paper to discuss the North American species of *Psylla* which have *Salix* spp. as their true hosts. In the case of several species, rearing studies demonstrate without question the existence of both nymphs and adults of a species on its host. In other instances, the presence of nymphs and teneral adults on the same willow is cited as provisional evidence of host relationship and of the coidentity of the nymphs and adults. Several other species, for which the nymphs are not known, are believed to breed on willow because of their obviously close relationship to species for which willow has been established as the host.

DISTRIBUTION

The *Salix*-inhabiting species in the genus *Psylla* are widely distributed in the Northern Hemisphere. Throughout this range a distinctive body form and color pattern are evident on mature specimens in many of the species. This is typified by *Psylla americana* Crawford in America, *P. pulchra* Loew in England and by *P. nigrita* Zett. from the Tatra (Carpathian) Mountains of the Balkan region. The American species conform to this basic pattern more faithfully than do some of the European species which live on willow.

The genus *Salix* is represented in North America by many species and can be found in almost any ecological habitat where fresh water occurs. However, the willow-inhabiting species of *Psylla* have been recorded predominantly from western North America, and particularly from western United States. Although many species of Psyllidae have been collected in Mexico only a few have been reported for the genus *Psylla* and only one, *americana*, is known to breed on *Salix*. Several species are known to be represented in Canada, but the great majority occur in the United States.

Twenty-one species are included in this study. Of this number 17 occur in the far west with 14 and possibly 15 species being restricted to the region west of 100° west longitude. In contrast, only two species are represented in the

extreme eastern part of North America and five are represented in the region between Nebraska and Pennsylvania. One species, *quadrilineata*, is known only from New York and New Hampshire. *P. arctica* has been collected but once, the locality being near James Bay, Ontario. *P. albagena* has been recorded only from Ohio and Iowa. However, *albagena* probably will prove to be a subspecies of *alba* which is predominantly western in its distribution. It is noteworthy that no records have been published of species of *Psylla* occurring on willow in the southern and southeastern regions of the United States.

The fact that most of the *Psylla* species on willow occur in the western United States is not peculiar to this genus. It is, in fact, typical of the situation in most of the psyllid genera in North America. The semi-desert and mountainous regions of the west, which have relatively low precipitation during the summer months, have proved to be rich in psyllid species compared to other parts of the country.

GENERAL BIOLOGY

In California the willow psyllids overwinter in the adult stage. This is probably true in many other localities as well. The adults apparently spend the winter in protected places or on plants other than willow. One species at least, *Psylla curta* Tuthill, can be collected on pine during the winter in the San Francisco Bay region and during the same period it cannot be found on willow.

Early in the spring, just as the willows are beginning to break dormancy, the dark colored, overwintering adults appear on the willows. There they feed on the woody twigs and lay their eggs on the expanding leaves and scales of the young catkins. In 1944 in San Bernardino, California, the dormancy of willows was broken during January. At higher elevations spring growth started later.

Most of the *Psylla* species on willow apparently produce but one generation a year. Adults mature soon after the willows have attained full leaf. Shortly thereafter few if any adults can be found on willow. Where the adults spend the rest of the summer is not well understood. *Psylla americana* has been collected on pine during the summer as well as in the winter and it is possible this plant harbors the species throughout much of the year except for the breeding season on willow. All of the collection records from willow for *americana*, *curta*, and, with one exception, for *tenuata* are during the spring and early summer months. Willows in San Bernardino County which produced large numbers of nymphs and adults of *americana* during March and early April were devoid of the species by April 30. *Psylla americana*, *parallela* and *breviata* occurred on willow in the Sierra Nevada Mountains in the spring of 1949, but not a single specimen in the genus *Psylla* could be found at the same localities when they were revisited July 14 and August 9. No specimens were found on either willow or pine at any of several localities searched in Plumas, Sierra and Nevada counties, California, during August 1949.

The known nymphs of all the *Psylla* species on willow are naked, i.e., they lack any covering of cotton-like waxy threads such as is associated with some species breeding on other hosts. Typically they feed on the catkins and young leaves or in the leaf axils on the tender new growth. During the last of their

five nymphal instars, and when ready to become adults, they move to the underside of the leaves to which the last nymphal exuvium is left attached.

SPECIES BREEDING ON WILLOW

Psylla alba Crawford

Psylla alba Crawford 1914

Psylla alba, *albigena* and *bulbosa* are apparently closely related and form a small but homogeneous group apart from the other *Psylla* species occurring on willow. They are generally whitish to light green in color, and have large, and only slightly divergent genal processes. The male forceps are slender, simple, and similar in form. The female genitalia also indicate close affinity among the three species.

Previous records. Crawford (1914) recorded *alba* from Claremont, Folsom and Sacramento (*Salix longifolia*), California; from Ormsby County, Nevada; Las Vegas, San Miguel County, New Mexico; and El Paso, El Paso County, Texas. Tuthill (1943) listed it from Nicolaus, Sutter County, California; Washington, Utah, Wyoming, Colorado, and Wisconsin.

New records. All records are from undetermined *Salix* spp. unless otherwise indicated. **California:** *San Diego County:* adults from Pala, January 17, 1940 (D.D.J.).⁴ *Orange County:* adults from *Salix hindsiana* along Santa Ana River, July 14, 1939 (D.D.J.); adults and nymphs from *Salix hindsiana*, Olive, July 9, 1942 (D.D.J.). *Los Angeles County:* Azusa, October 15, 1947 (R. Flock). *Riverside County:* Santa Ana Canyon, March 30, 1942 (D.D.J.); adults from willow with buds just beginning to swell, Moreno, January 28, 1944 (D.D.J.). *San Bernardino County:* nymphs and adults from *Salix hindsiana*, Mill Creek Canyon, April 30, 1943 (D.D.J.); adults from willow just beginning to leaf out, Yucaipa, February 2, 1943 (D.D.J.). *Inyo County:* adults and nymphs, Bishop Creek (elevation 6000 feet) near Bishop, August 1, 1941 (D.D.J.). *Tulare County:* adults from Woodlake, September 16, 1946 and May 21, 1948 (D.D.J.). *Fresno County:* adults without host data, Firebaugh, April 22, 1948 (R. F. Smith). *San Joaquin County:* adults, Corral Hollow, near Tracy, November 4, 1929 (P. N. Annand). Annand's specimens were reported by Klyver (1932) as *Psylla americana minor*. *Yolo County:* Winters, March 13, 1947 (D.D.J.). *Plumas County:* one female, Hallelujah Junction, August 10, 1949 (D.D.J.). **Washington:** adult from Yakima, Yakima County, July 11, 1943 and from Wenatchee, Chelan County, July 14, 1943 (D.D.J.); adults from Maryhill, Klickitat County, November 6, 1941 (D.D.J.). **Idaho:** one male from *Cercocarpus ledifolius*, Pollock, Idaho County, October 16, 1941 (D.D.J.). **Utah:** adults from Hurricane, Washington County, August 28, 1940 (D.D.J.); adults from Moab, Grand County, October 31, 1939 (D.D.J.); adults from Midvale, Salt Lake County, July 20, 1948 (D.D.J.). **Colorado:** *Mesa County:* adults from Mack, November 1, 1939, and from Palisade, November 3, 1939 (D.D.J.). **New Mexico:** adults from alfalfa, Messila, Dona Ana County, December 4, 1939 (D.D.J.); adults from Espanola, Rio Arriba County, June 3, 1943 (D.D.J.). **Texas:** adults from Ft. Hancock, Hudspeth County, December 4, 1939 (D.D.J.).

⁴ Collections made by D. D. Jensen are indicated by initials D.D.J.

Range. California, Nevada, Washington, Idaho, Wyoming, Utah, Colorado, New Mexico, Texas, Wisconsin.

Biology. *Psylla alba* appears to differ somewhat in its general biology from the other *Psylla* species on willow which have been studied in California. If *americana* or *tenuata*, for example, have more than one generation a year on willow, the second brood must be small and inconspicuous. On the basis of limited observations, *Psylla alba* in contrast may have overlapping broods on willow or at least appears to have more than one generation a year. On April 30, 1943 nymphs were found maturing on *Salix hindsiana* at Mill Creek Canyon, San Bernardino County, California. The nymphs were naked and in the leaf axils of the youngest shoots. Their heads were directed down the stem. A branch was caged and the adults were reared out. Only *alba* emerged, thus confirming the identity of the nymphs.

On July 9, 1942 nymphs as well as adults were found on willow near Olive, California. This is a locality where spring comes very early, January and February typically being the months in which the dormancy of willows is broken. The presence of nymphs as early as April and as late as July indicates more than one brood a year.

Psylla albagena (Caldwell)

Psylla albagena Caldwell 1938

Caldwell described *Psylla albagena* from specimens reared on sandbar willow, *Salix interior* (= *longifolia* Muhl.) in Pickaway County, Ohio. He described the immature stages as well as the adults and includes life history data.

In a letter to the writer dated November 8, 1949, Caldwell stated he had specimens of *albagena* from as far west as Iowa.

Range. Ohio, Iowa.

The writer has examined two paratypes of *albagena* mounted on points. Their similarity to *alba* is so great that *albagena* should probably be considered a subspecies rather than a distinct species. However, in the absence of more material for study, such a change is not proposed at this time. *Psylla albagena* differs from *alba* primarily in the form of the female genitalia. The dorsal surface of the dorsal valve of both species is sinuate. However, the apex in *alba* is somewhat thickened and appears turned up whereas in *albagena* Caldwell described the apical fourth as being straight.

Caldwell's illustration of the nymph of *albagena* closely resembles the nymph of *alba*.

Psylla bulbosa Tuthill

Psylla bulbosa Tuthill 1943

The type specimens of this species were collected on *Salix taxifolia* at Ruby, Santa Cruz County, Arizona. Other specimens were recorded by Tuthill from Turkey Creek and Nogales, Santa Cruz County, Arizona.

New record. Fourteen adults collected on *Salix taxifolia* at Bear Valley, Tumacacori Mountains, Arizona, June 28, 1940 (R. A. Flock).

Range. Ruby, Turkey Creek, Nogales, Bear Valley, Arizona.

Psylla americana Crawford

Fig. 1, B, D

Psylla americana Crawford 1914

The adults of several species of willow-inhabiting psyllids are approximately the same size and have the same type of coloration and general body structure. Final identification therefore is usually dependent on an examination of the genitalia, particularly that of the males. Previous descriptions and illustrations of the male forceps of *americana* have failed to bring out the structure of the apices which have a unique and characteristic hook. This cannot be seen from either a lateral or the caudal view, but is evident from the dorsal aspect. On dry specimens the forceps usually are drawn up against the proctiger in such a position that the apices are completely invisible from all aspects. The genitalia can best be studied on specimens preserved in alcohol, or mounted on a slide.

The proctiger is 0.4–0.5 mm long and has short pubescence. The sides are parallel to the bluntly rounded apex. The forceps are sparsely pubescent, subequal in length to the proctiger, broad throughout the proximal three-fourths of their length, then rapidly narrowed and bent mesad at right angles to form horizontal hooked apices. The posterior margin is straight except for a weak convexity near the base. The anterior margin is deeply incised in the basal third, then broadly convex to the narrowed distal portion. The apex is not visible in profile, but from the dorsal view is seen as a small, heavy, black hook with the tip directed anteriorly (Fig. 1, B).

Previous records. Many of the published collection records of this species cannot be accepted as referring to *americana* because several species were confused by Crawford and others. However, the type specimens were collected near Claremont, California on *Pinus ponderosa*. Tuthill (1943) listed the species as occurring in several unnamed localities in California, Utah, and Colorado. Caldwell (1944) recorded *americana* from Rio Frio, Puebla, Mexico, on pine.

New records. All records are from *Salix* spp. unless otherwise indicated.

California: *San Diego County:* Pala, January 17, 1940 (D.D.J.); adults from undetermined hosts: March 12, 1914 (E. P. Van Duzee); Pine Valley, April 24, 1914 (W. M. Giffard). *Riverside County:* Hemet, January 29, 1940 (D.D.J.); Moreno, February 9, 1943, January 28, 1944 (D.D.J.). *San Bernardino County:* nymphs and adults, Bar Bear and Big Bear Lake, June 7, 1942 (D.D.J.); San Bernardino, March 7, 1940 (D.D.J.); Yucaipa, February 2, 1943 (D.D.J.); adults and eggs, San Bernardino Mountains (2500 feet) January 20, 1944 (D.D.J.); nymphs only from *Salix lasiandra*, Mill Creek Canyon, March 12, 1943 (D.D.J.); nymphs and adults from same location April 1, 1943 (D.D.J.); adults from undetermined host, Verdement, April 25, 1923 (E. P. Van Duzee). *Monterey County:* adults from undetermined host, Bradley, April 23, 1917 (E. P. Van Duzee); San Ardo, March 24, 1931 (Van Duzee). *Stanislaus County:* nymphs and adults (in association with *Psylla curta*), Adobe Creek, 22 miles east of Patterson, May 6, 1948 (J. W. MacSwain). *Fresno County:* adults, Fresno (U. S. National Museum record). *Contra Costa County:* nymphs and adults (in association with nymphs and adults of *Psylla curta*), Walnut Creek, April 4, 1949 (D.D.J.); adults from

undetermined host, Byron, April 23, 1927 (Van Duzee). *Sacramento County*: Sacramento, March 30, 1929 (H. H. Keiffer). *Butte County*: Oroville, April 7, 1928 (H. H. Keiffer). *Plumas County*: overwintering adults, with adults of *Psylla breviate* and *P. parallela*, Bucks Lake, May 13, 1949 (J. W. MacSwain). *Nevada County*: nymphs and adults, together with nymphs and adults of *Psylla breviate*, Hobart Mills, June 26, 1949 (D.D.J.). *Placer County*: adults from undetermined host (Koebele). This record was included in Crawford's original description of the species. Specimens bearing the same data are in the collection of the California Academy of Sciences and permit confirmation of the species in this county. *Shasta County*: adults from *Pinus* sp., Bumpas Hell, July 2, 1947 (T. O. Thatcher). *Siskiyou County*: Bray, (U.S.N.M. record).

Oregon: adults and nymphs from willow (in association with *Psylla fibulata* and *P. alba*), Meacham, Umatilla County, July 10, 1943 (D.D.J.).

Washington: adults, Chelan County, October 29, 1942 (pear psylla survey collection).

Range. Washington, Oregon, California, Utah, Colorado, Mexico.

Biology. Eggs. Overwintering adults lay their eggs on the willows as they are beginning to break dormancy in the spring. On January 20, 1944, adults were laying their eggs on the expanding catkins of willow located on the road between San Bernardino, California and Lake Arrowhead at an elevation of 2500 feet. The eggs were found on the pistillate catkins and occurred, usually a single egg to a scale, attached to the outer surface and a little below the dark distal portion of the scale. The stipe by which the egg is attached is short and not visible without some dissection. It arises from the blunt, proximal end of the egg at a 45° angle and is directed at about a 45° angle from the scale surface. Thus the egg stands in an almost perpendicular position parallel with the surface of the scale. The eggs are cream colored to yellowish. They are 0.35 mm long, 0.16 mm wide at the widest point and the stipe is 0.07 mm long.

Nymphs. At Mill Creek Canyon, San Bernardino County, overwintering adults were common on *Salix lasiandra* February 2, 1943. By March 12, 1943 the willows were bearing pistillate catkins and nymphs of *americana* were feeding on the catkins in large numbers. No adults were found at this time, presumably having died after oviposition. By April 1 the catkins had dried on most of the branches and the nymphs were found on the tender terminal growth, feeding in the axils of the leaves. Teneral adults as well as nymphs were present in large numbers on this date. When the last-instar nymphs are ready to transform into adults, they move to the blade of a nearby leaf where the last molt takes place and the nymphal exuvium is left attached to the leaf, usually on the underside. The same willows which had yielded nymphs March 13, and adults and nymphs April 1, were examined on April 30, but on this date neither nymphs nor adults could be found.

On March 12, 1943, some of the branches which carried nymphs on the pistillate catkins were cut and taken to the laboratory where the cut ends of the branches were placed in water. A cloth sleeve cage enclosed the foliage. Within a day the nymphs left the catkins and fed in the leaf clusters, in the axils of the leaves and on the young woody stems and twigs bearing the previous year's growth. As the leaves and catkins wilted, the nymphs confined

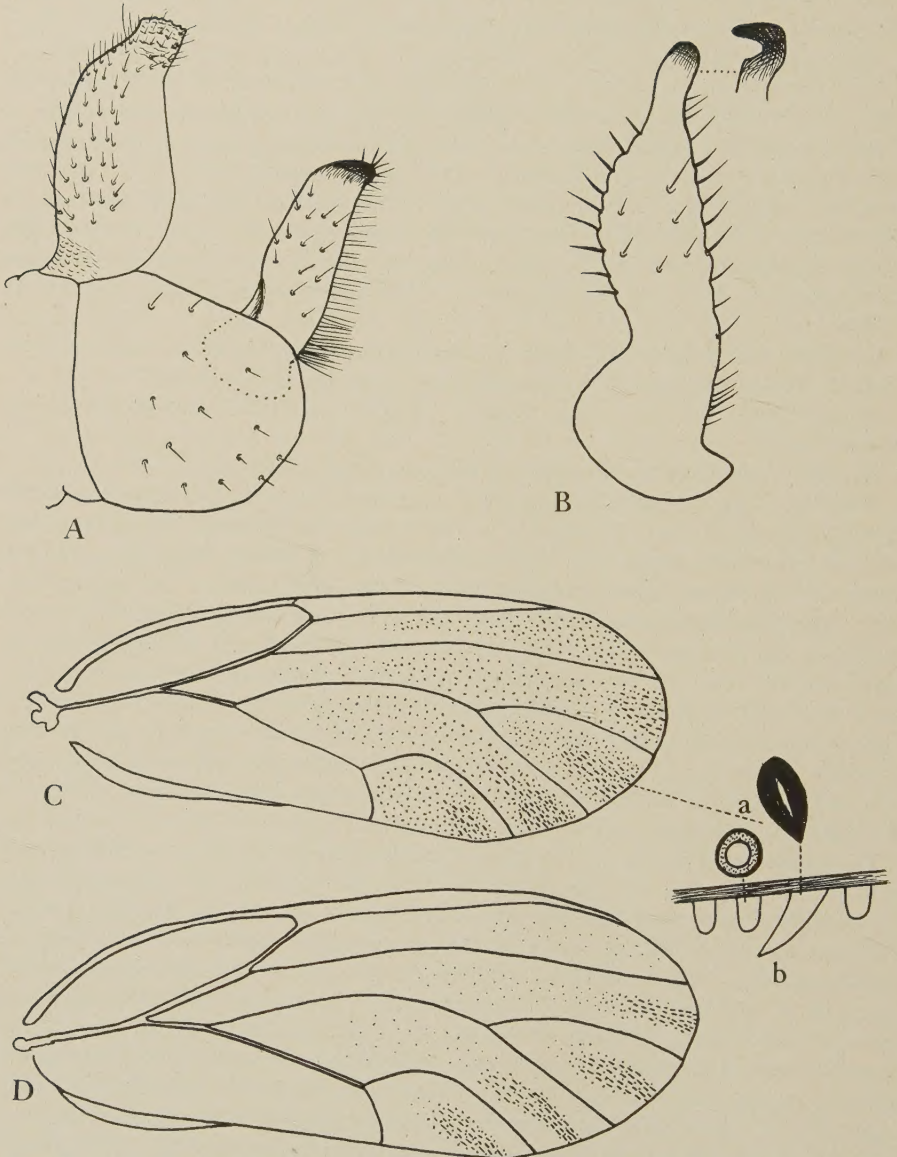


Fig. 1. A, male genitalia of *Psylla curta* Tuthill, lateral view. B, male forceps of *Psylla americana* Crawford, outer face in lateral view with apex as seen in dorsal view. C, forewing of *P. curta* showing distribution of setae on wing membrane; a, enlarged view of two types of setae on wing membrane as seen when wing is in horizontal position; b, form of two types of setae on wing membrane in profile view. D, forewing of *P. americana* showing setae on wing membrane.

their feeding to the twig growth. By March 30 many had attained the adult stage.

Psylla americana nymphs and adults will feed on plants other than willow, but the development from eggs to adults apparently only occurs on this host. For example, on May 6, 1943 adults and fifth-instar nymphs were collected from willow at Oak Glen, San Bernardino County, and caged on the foliage of a peach tree infected with peach mosaic at Moreno, California. They were left on this peach for two days before transfer to a healthy peach tree. During the two days on diseased peach nearly all of the nymphs transformed into adults and very few of the adults died.

The nymphs are naked and most of them are honey yellow in color. The abdomen on some specimens, however, is dark brown.

Adult feeding. Overwintering adults collected on willow from Live Oak Canyon, San Bernardino County, February 2, 1943 were caged on twigs bearing newly opened buds. All of the adults were observed to feed on the green twigs and none fed on the leaves. Small globules of liquid excrement served as evidence that feeding was taking place.

Parasites. On April 1, 1943, at Mill Creek Canyon, San Bernardino County, California, two nymphs of *americana* were found to be parasitized. A single adult wasp emerged from each of the nymphs, one appearing April 8 and the other April 10. Emergence occurred through a circular hole cut in the dorsum of the abdomen. The parasites were determined by Mr. A. B. Gahan, of the U. S. National Museum, to be a new and as yet undescribed species of *Prionomitus* (family Encyrtidae).

A single nymph of *americana* collected by the writer at Hobart Mills, California, June 26, 1949 was found to be parasitized. The adult encyrtid parasite emerged but is as yet unidentified.

Psylla curta Tuthill

Fig. 1, A, C

Psylla americana curta Tuthill 1943

Tuthill (1943) described *curta* provisionally as a subspecies of *americana*. However, *curta* should have species rank as the two are readily distinguishable morphologically. Moreover, they are sympatric species and show no evidence of intergradation.

The males possess widely different forceps. In *americana* (Fig. 1, B) they are broad and curved in the basal two-thirds above the subgenital plate, then taper sharply terminating in a distinct, horizontal hook. In *curta* the forceps are stout, simple in form and curve meso-caudad distally to terminate in blunt apices (Fig. 1, A).

The species can also be separated readily on the basis of the markings on the forewings. This is particularly useful in distinguishing the females since the genitalia of this sex are similar among several of the willow psyllids.

Although Tuthill described both *curta* and *americana* as having the membrane of both wings thickly set with minute setae there is a relatively conspicuous difference between the two species with reference to the forewings. In *curta* (Fig. 1, C), at least the distal half of the wing membrane carries numerous dark dots and they occur practically from vein to vein rather than

being restricted largely to the median area between the veins. Moreover, they are conspicuous over this entire area when viewed under the dissecting microscope either on dry wings or on wings mounted on slides. In *americana*, in contrast, the readily evident pattern is restricted to a much smaller patch extending back from the wing margin between the veins (Fig. 1, *D*). Only with difficulty can the presence of small dots be made out over the middle portion of the wing membrane. This difference has been found to occur consistently on the hundreds of specimens I have examined.

These dark spots are not caused by the same type of structure throughout the wing. Under the compound microscope the larger setae can be seen to occur only as a small patch near the wing margin between the veins. They are elongate and curve distally, terminating in an acute apex. The spots which occur over most of the membrane, and to a lesser extent among the larger setae, appear under the compound microscope as rings (Fig. 1, *C, a*) when the wing is viewed in a horizontal position. However, when a small piece of the wing is mounted so that it can be examined in profile under the compound microscope, these spots can be seen to be small setae which are straight, short, bluntly rounded distally and produced at right angles to the wing membrane (Fig. 1, *C, b*). This is true for both *curta* and *americana*.

Previous records. Tuthill (1943) recorded *curta* from Colorado and from several California localities, i.e., Del Mar, San Diego County; Los Angeles County; Monterey, Monterey County; Lompoc, Santa Barbara County; San Jose, Santa Clara County; San Francisco; Berkeley, Alameda County; and from Fieldbrook and Little River, Humboldt County.

Except for Tuthill's report of *curta* occurring in Colorado, all known records are from California and Oregon. Moreover, the species is confined primarily to the coastal region. In view of this restricted distribution and the absence of *curta* from the Sierra Nevada Mountains and from the Great Basin, the report of the species from Colorado seemed questionable. Dr. Tuthill referred me to the University of Kansas for Colorado specimens identified as *curta*. Dr. Beamer kindly sent a pinned male collected by Paul W. Oman at Sloss, Colorado, August 17, 1929. This specimen had been designated by Tuthill as a paratype of *Psylla americana curta*. The forceps of this individual were drawn up under the apex of the proctiger in such a manner that only the basal portion of the forceps was clearly visible. However, when the abdomen was removed and cleared a study of the genitalia then proved the specimen unmistakably to be *Psylla minor*. In view of this circumstance I consider the known distribution of *curta* to be limited to California and Oregon.

New records. All collections were from *Salix* spp. unless otherwise indicated.

California: *San Luis Obispo County:* adults without host data from Atascadero, April 23, 1932 (Van Duzee). *Kern County:* Cawelo, May 10, 1949 (E. S. Sylvester). *Monterey County:* adults without host data from San Ardo, March 24, 1931 (Van Duzee); Carmel, May 11, 1930 (L. S. Slevin); Point Sur, April 10, 1937 (D.D.J.); adults from *Pinus radiata*, August 15, 1938 (Van Duzee); Bradley, April 23, 1917 (Van Duzee). *San Benito County:* Pinnacles National Monument, April 24, 1948 (P. D. Hurd). *Santa Cruz County:* June 10, 1917 (W. M. Giffard); Ben Lomond, April 9, 1937 (D.D.J.);

Watsonville, February 21, 1947 (D.D.J.); adults without host data from Santa Cruz Mountains (Koebele). *Santa Clara County*: adults and nymphs, Alum Rock Park, April 9, 1937 (D.D.J.). *Stanislaus County*: adults and nymphs (with *Psylla americana*), Adobe Creek, 22 miles east of Patterson, May 6, 1948 (J. W. MacSwain); adults only from *Baccharis* on same date and at same location (R. F. Smith and J. W. MacSwain). *San Mateo County*: Salada Beach, April 21, 1918 (E. P. Van Duzee); adults without host data, Portola Valley, May 4, 1917 (W. M. Giffard); adults without host data from Half Moon Bay, May 16, 1922 (E. O. Essig and S. E. Flanders); Half Moon Bay, March 5, 1947 (D.D.J.); adults common on 3 needle pine, Sharp Park, October 4, 1946 (E. Klostermeyer). *San Francisco County*: adults from undetermined host, San Francisco, April 11, 1915 (Van Duzee). *Alameda County*: adults from pine, Berkeley, October 13, 1948 (D.D.J.). *Contra Costa County*: Pinole, May 1, 1937 (D.D.J.); Marsh Creek, April 24, 1937 (D.D.J.); overwintering adults, *Salix lasiolepis* Orinda, March 4, 1949 (J. W. MacSwain); adults from *Ribes* sp., east entrance of Tunnel, March 13, 1947 (D.D.J.); adults and nymphs (in association with adults and nymphs of *Psylla americana*), Walnut Creek, April 4, 1949 (D.D.J.). *Marin County*: overwintering adults, Muir Beach, February 8, 1947 (D.D.J.); adults and nymphs, Taylor State Park, May 8, 1949 (D.D.J.). *Sonoma County*: Alpine Valley, April 15, 1938 (M. Embury); overwintering adults, Occidental, February 5, 1947 (D.D.J.). *Napa County*: adults and nymphs, Larkmead, May 11, 1948 (D.D.J.)

Oregon: adults from unrecorded host, Waldport, Lincoln County, June 5, 1925 (E. P. Van Duzee).

The distribution of *curta* in relation to *americana* is of interest. The latter species occurs near the coast at Monterey and in the San Francisco Bay area. These are regions where *curta* is abundant and where *americana* is found less frequently. The occurrence of *curta* in Stanislaus County and Kern County represents an overlapping of the distribution of *americana*. In two cases (in Stanislaus County and in Contra Costa County) adults and nymphs of both species occurred together on the same host plants.

Range. California, Oregon.

Biology. *Nymphs.* On April 4, 1949 willows at Walnut Creek, Contra Costa County, California, were found infested with nymphs of *P. curta* and *americana*. The nymphs of both species were predominantly green, although some had a brownish cast to the body.

The willows were in leaf and bore staminate catkins. The nymphs occurred on the catkins and among and at the base of the terminal leaves. Cloth sleeve cages were placed on branches which were cut and taken to Berkeley where the cut ends were placed in water. The leaves of willow wilt rather quickly after the branches are cut. Loss of water from the youngest leaves appears to be reflected immediately by movement of the nymphs from the leaves to the shoots themselves. On April 6, the nymphs were feeding on the leaf petioles, especially near their bases, on the young woody stems, particularly in the leaf axils, and on the previous year's wood. On April 14, after all the leaves had dried, the nymphs were still feeding on the green wood of the branches. In the meantime many had matured into adults.

The nymphs produce an anal wax tube during feeding which, under field conditions, dries, shrinks and curls somewhat as it is produced. Individual nymphs were caged in separate glass vials, each with a leaf, to rear out the adults and correlate the nymphal exuviae with the adults which emerged. The atmosphere in the vials became saturated with moisture and the anal wax tubes produced did not dry, but expanded into a hollow ball with a diameter of 0.6 mm. In its expanded condition the tube could be seen to be composed of wax which was regularly striated or ribbed longitudinally as it was produced.

Of the adults which emerged in the cage, approximately 75 per cent were *P. curta* and 25 per cent were *americana*.

Psylla minor Crawford

Psylla americana minor Crawford 1914

Psylla minor Tuthill 1943

Psylla minor Crawford was described as a variety of *americana*. Much of the material which Crawford considered to be *minor*, however, proved to be a distinct species which Tuthill (1943) described as *Psylla americana curta*. Tuthill recorded *minor* from Oregon, Washington, and Colorado with *minor* var. *flava* Crawford listed as occurring in British Columbia, Oregon, California, Utah, and Colorado.

The specimens collected from willow at Puyallup, Pierce County, Washington, February 26, 1932 by William W. Baker and reported by Klyver (1931b) as *Psylla parallela* are actually *minor*.

I think it is very possible that *flava* is not a valid variety. The specimens found late in the autumn and those that survive the winter are dark in color while the teneral and summer forms are usually lighter.

The writer has thus far failed to find *minor* among the California specimens available for examination.

Host records. Crawford's records of *minor* from California on *Salix lasiolepis* and *Salix californica* actually refer to *Psylla curta*. Tuthill (1943) reported several collections from willow. In the new records listed below both adults and nymphs were taken on willow, except for the British Columbia collection.

New records. Adults and nymphs from *Salix* sp., Brighton, Salt Lake County, Utah, June 25, 1943 (D.D.J.); adults and nymphs from *Salix* sp., Fishing Bridge, Yellowstone National Park, Wyoming, July 25, 1948 (D.D.J.). Two male adults of *P. sinuata* were among the specimens taken at Fishing Bridge. The fact that several of the adults of *minor* taken at Fishing Bridge were very teneral makes it highly probable that the associated nymphs are also *minor*. **British Columbia:** Adults from Ker-Cauwston, March 26, 28, 1944 (pear psylla survey collection).

Range. British Columbia, Washington, Oregon, Wyoming, Colorado, Utah, California.

Psylla parallela Crawford

Fig. 2, E

Psylla parallela Crawford 1914

The literature contains no authentic record of this species having been taken since the type series of four males and one female from Nevada County,

California. These were collected by Koebele. Klyver (1931b) reported *parallela* as occurring in Washington and British Columbia. His identification of the species in these instances was probably incorrect. The writer has examined one of his slides, labeled "*Psyllia parallela*," in the Stanford University collection, and found the specimens to be *Psylla minor* Crawford as surmised by Tuthill (1943). The specimens in question were collected from willow at Puyallup, Washington, February 26, 1932 by William W. Baker.

New record. On May 13, 1949 one male adult of *parallela* was collected on willow at Bucks Lake, Plumas County, California, by J. W. MacSwain. The specimen was very dark in color and was unquestionably an overwintering individual. It was taken in association with adults of *Psylla brevata* and *Psylla americana* on willows which were surrounded by snow and were without leaves but had produced catkins. No specimens were found when the writer swept the same willows on June 27, July 14 and August 9.

Host plant. No host data have been previously available for *parallela*. Although it has not yet been collected in its immature stages on willow, there can be little doubt that this is its host. In general appearance the species is typical of a large group of willow psyllids. Moreover, the forceps (Fig. 2, *E*) indicate relationship to *Psylla spiculata* Jensen which is known to breed on willow at high elevations in the southern Sierra Nevada Mountains of California.

Range. California: Plumas and Nevada counties.

Psylla spiculata Jensen, new species

Fig. 2, *A, B, C, D*

Color. General color greenish yellow to pale orange. Most adults collected were teneral specimens, so fully mature coloration is not known but is probably dark brown. Antennae light to dark brown in proximal third, becoming black distally. Forewings clear with veins yellow proximally, becoming dark brown apically, and bearing a brown area along margin at tip of clavus; pterostigma yellow opaque.

Structure. Length to tip of folded wings 3.2–3.7 mm; length of body 2.2–3.0 mm; length of forewings 2.6–3.0 mm; width of head 0.75–0.8 mm; length of antennae 1.0 mm. **Head** (Fig. 2, *A*) deflexed at 45° angle or greater; vertex with 2 deep discal foveae near posterior margin, strongly arcuate along posterior margin; anterior portion bulging forward and strongly emarginate at median suture; genal processes equal in length to vertex at median line, slender, moderately divergent, subacute at apices, bearing sparse but long pubescence. **Forewings** (Fig. 2, *D*) about two and one-third times as long as wide, broadly rounded at apex; pterostigma large.

Genitalia. Male. (Fig. 2, *B*). Proetiger 0.4 mm long; forceps 0.35 mm long; in caudal view forcep almost straight from dorsal surface of ventral genital valve to apex; basally bowed mesad to join other forcep; in lateral view posterior margin almost straight to near apex where it is somewhat emarginate and bluntly rounded caudally to form posterior process of apex; anterior margin produced proximally to form a thin, rounded, flap-like flange which is appressed to inner face of ventral genital valve just below dorsal surface of valve; with the exception of a short separating emargination above basal

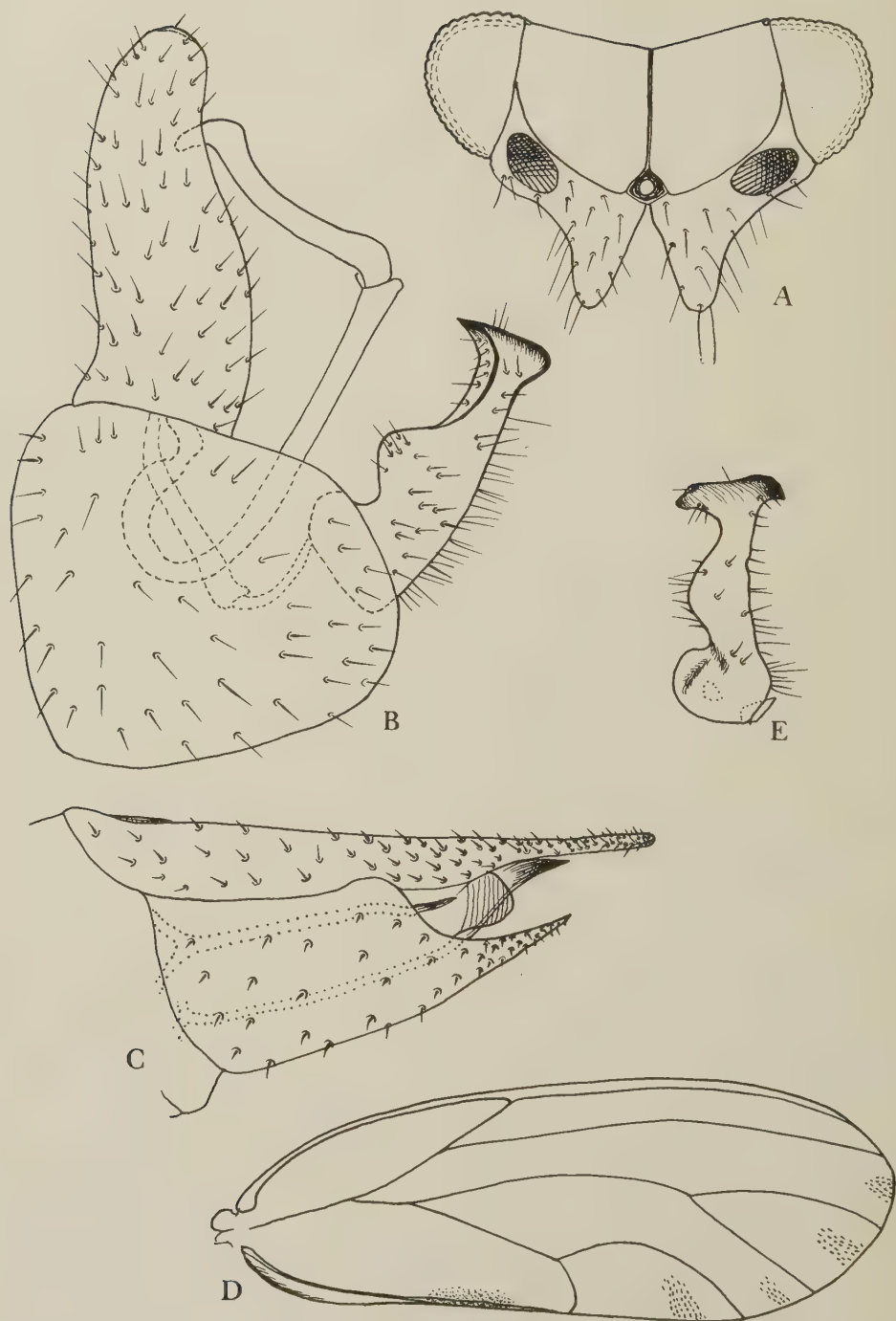


Fig. 2. *Psylla spiculata* n. sp. A, head; B, male genitalia; C, female genitalia; D, forewing. *Psylla parallela* Crawford. E, male forcep outer face.

flange, the anterior margin is again produced cephalad to form a rounded lobe; above this lobe the forcep tapers to a slender shank which terminates apically in a black, anteriorly and posteriorly produced apex; in lateral view anterior portion of apex is longer, thin, and acute in comparison with short, thick, bluntly rounded posterior portion; inner face of forceps pubescent, thickly along posterior margin. **Female** (Fig. 2, *C*). Genitalia 1.0 mm long, longer than rest of normally distended abdomen; dorsal valve longer than ventral, slender toward subacute apex, beset with short setae which become more numerous and heavier apically.

Host. *Salix* sp.

Type locality. South Lake (elevation 9700 feet) near Bishop, Inyo County, California.

Holotype, male, **allotype**, female, 16 male and 11 female paratypes, as well as many nymphs, collected on *Salix* sp., South Lake, near Bishop, California, August 1, 1941 by D. D. Jensen. Holotype, allotype and paratypes will be deposited in the U. S. National Museum. Paratypes will be deposited in the California Academy of Sciences and in the author's collection.

Most of the adults collected were teneral. The nymphs presumably belong to this species. They were naked and fed on the leaves.

Taxonomy. This species is most closely related to *P. parallela* Crawford but is easily distinguishable on the basis of the male genitalia. The forceps of *spiculata* are straighter, lack the posterior basal protuberance of *parallela*, have a long shank between apex and anterior lobe, and have smaller, asymmetrical apices.

Collected with *spiculata* were three males which resemble *P. hamata* Tuthill somewhat in the form of the male forceps. The apex is produced strongly cephalad as illustrated for *hamata*. However, the subapical shank is not emarginate as in *hamata* but is broad, extending cephalad almost to the tip of the apex, and is excavated along the cephalic half of the outside surface. None of the females collected with *spiculata* males has the tip of the dorsal genital valve thickened and turned up as is the case in *hamata*.

Psylla breviata Patch

Psylla breviata Patch 1912

Fig. 3, *C*

Psylla breviata Patch has been and remains a species of questionable identity. The original description was based on three females from Dow's Swamp, Ottawa, Ontario, 1903. Crawford (1914) described what he considered to be the male from collections which included males and females from Marquette, Michigan and from Placer and Nevada counties and the Argus Mountains (Inyo County) of California.

Whether or not the species represented by these males is the same as that originally described by Patch is uncertain. Thus far only California males have been illustrated. It is highly doubtful that the California species is the same as that reported by Patch.

Prior to the present record, *breviata* had not been collected since 1903 and its host plant had been unknown. Koebele collected some of his California specimens on *Pinus monophylla* in 1891, but this cannot now be construed as the host plant.

The specimens reported by Klyver (1931a) as *breviata* from southern Utah and southern Nevada are a distinct species, *P. confusa* Tuthill. These specimens mounted on slides, are in the entomology collection at Stanford University and were examined by the writer.

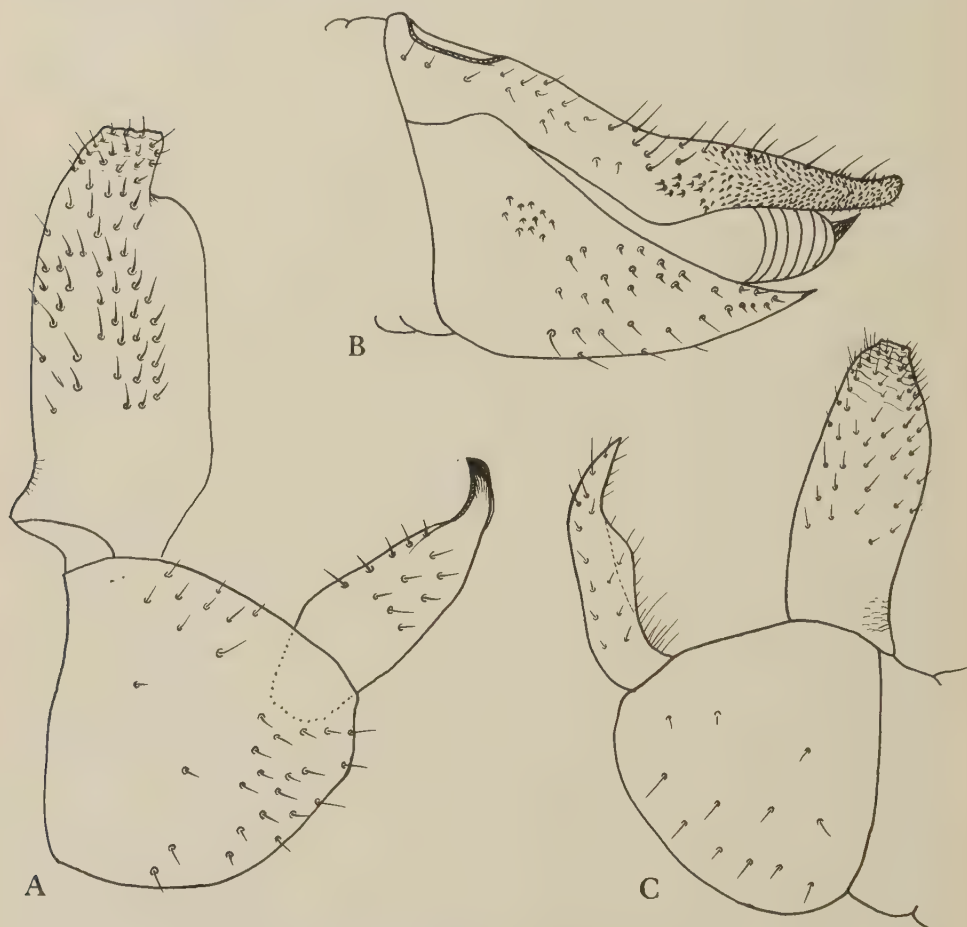


Fig. 3. *Psylla tenuata* n. sp. A, male genitalia in lateral view; B, female genitalia. *Psylla breviata* Patch. C, male genitalia in lateral view.

New records. On May 13, 1949 several dark-colored adults were taken from willow at Bucks Lake, Plumas County, California by J. W. MacSwain. These specimens were probably overwintering forms. They were taken in association with 1 male of *Psylla parallela* and 13 adults of *americana*. On June 26, 1949 the writer collected nymphs and teneral adults of *breviata* from willow at Hobart Mills, Nevada County, California. The nymphs were naked and occurred on the leaves. Two nymphs were found to be parasitized.

When the writer visited Bucks Lake on June 27, July 14 and August 9, 1949, no *Psylla* species could be found on willow or pine. Collections from Hobart Mills on August 10 also failed to yield specimens in the genus *Psylla*.

In California *breviata* apparently is restricted to the eastern mountains. A distinct but related species, *Psylla tenuata* Jensen, occurs at the lower elevations in the interior valleys of California.

Range. Ontario, Canada; Marquette, Michigan; Inyo, Placer, Nevada, and Plumas counties in California.

Parasites. Among the nymphs of *breviata* collected by the writer at Hobart Mills, California, June 26, 1949 were two which were parasitized. The adult parasite emerged from one nymph and the parasite in another nymph developed to the adult stage but died without emerging. They belong to the family Encyrtidae, but have not yet been identified.

Psylla tenuata Jensen, new species

Fig. 3, A, B

Color. Light green or greenish yellow in color for several days after becoming adults; mature coloration brownish orange to dark brown with variegated markings on dorsum; vertex and genae usually lighter; posterior margin of prescutum and four longitudinal stripes on scutum ochraceous; abdomen usually fuscous to black; antennae brown to black, lighter proximally; forewings clear, veins yellow to light brown; pterostigma ochraceous opaque.

Structure. Length to tip of folded wings 3.2–3.46 mm; length of body 2.4–2.6 mm; width of head 0.7–0.8 mm; length of antennae 0.9–1.1 mm. **Head** deflected at about 45° angle in life, appearing vertically deflexed on dry specimens, about same width as thorax; vertex rugose-punctate with a deep discal fovea near areolate posterior margin on each side of median suture; anterior portion of vertex bulging forward on each side of, and strongly emarginate at median suture; genal processes 0.2 mm long, equal to length of vertex at median line, thickened and contiguous basally, slightly divergent, subacute at apices, sparsely pubescent with moderately long white hairs. **Thorax** punctate. **Forewings** a little more than twice as long as wide; pterostigma moderately large.

Genitalia. Male. (Fig. 3, A). Proctiger 0.35–0.4 mm long, simple in form, minutely pubescent; forceps 0.25–0.3 mm long, about 0.1 mm broad over most of proximal two-thirds of length which is more or less straight-sided; anterior and to a lesser degree posterior margins rapidly taper toward each other distally to produce a slender, antero-medially curved, dark tooth-like process terminating in an acute apex; in caudal view postero-mesal margin of apical process produced somewhat as a rounded ridge or ledge. **Female.** (Fig. 3, B). Genital segment 0.9 mm long, about same length as rest of normally distended abdomen; dorsal valve longer than ventral, slender, sparsely pubescent, dorsal surface slightly depressed midway, thickened dorsally at extreme apex so that tip appears somewhat upturned.

Host plants. *Salix laevigata*, *Salix* spp. **Food plant.** *Populus* sp.

Type locality. Colton, San Bernardino County, California.

Holotype, male, **allotype**, female and 36 paratypes collected on *Salix laevigata*, Colton, California, February 5, 1944, by D. D. Jensen. Holotype and allotype will be deposited on loan in the California Academy of Sciences. Paratypes will be deposited in the California Academy of Sciences, the U. S. National Museum and in the author's collection.

Records. Adults and nymphs were collected from the type host and locality March 13, 24 and April 7 and 16, 1943 (D.D.J.). Adults from willow and cottonwood, San Bernardino, California, March 10, 1942 (D.D.J.). Adults from willow, Redlands, San Bernardino County, July 2, 1938 (D.D.J.) Adults and nymphs from willow, Riverside, Riverside County, California, April 2, 1940 (D.D.J.) One male from San Diego County, May 7, 1913 (Van Duzee). Two males and 1 female from willow, Cawelo, Kern County, May 10, 1949 (E. S. Sylvester). Adults and nymphs from *Salix laevigata*, Woodlake, Tulare County, May 21, 1948 (D.D.J.). One male from Coarsegold, Madera County, May 12, 1942 (W. F. Chamberlain). One male and 1 female from willow, Winters, Yolo County, March 14, 1947 (D.D.J.). Two males and 1 female from willow, Clarksburg, Sacramento County, April 26, 1938 (D.D.J.)

Range. California: San Diego, San Bernardino, Riverside, Kern, Tulare, Madera, Sacramento, and Yolo counties.

Taxonomy. This species is related to *Psylla breviata* Patch but is readily distinguishable. The proctiger of *tenuata* is longer, the forceps in lateral view are much broader, less straight, and taper from both posterior and anterior margins to form a longer apical process than occurs in *breviata* which has an emargination only along the anterior margin of the forceps (Fig. 3, C).

Biology. Observations were made on the various life stages of *P. tenuata* on its host plant, *Salix laevigata* Bebb., at Colton, California. On February 5, 1944, dark-colored overwintering adults were found on the willow in moderately large numbers. The leaf buds were beginning to open and the staminate catkins were developing. The adults fed on the woody twigs and not on the fresh, green foliage. Eggs were laid on the outside of the very young, densely pubescent leaves surrounding the base of the newly developing catkins. The eggs are 0.4 mm long and 0.15 mm at the widest point. They were attached to the leaf with a short stipe from the basal or blunt end of the egg. The egg does not stand on end, but has its long axis nearly parallel with the substratum, the slender apical end of the egg being directed toward the distal portion of the leaf.

One female was dissected and contained 35 mature eggs.

During March and April of the preceding year, 1943, the development of the nymphs was checked at irregular intervals at Colton, California. On March 13, the willow tree had staminate catkins near full development. Many nymphs, in their early instars, were found feeding on the catkins with their heads directed toward the stem. On March 28, nymphs and adults were common. The young nymphs fed on the staminate catkins where they were concealed by the floral parts. As the nymphs became older they moved to the axils of the leaves, where they fed on the tender shoots or in the folds of the growing terminal leaves.

By April 7, most of the nymphs were in their last instar. When ready to become adults they moved to the underside of a leaf and molted, leaving the cast skin attached to the leaf.

On April 16, no living nymphs were found. Adults were still present although in low numbers.

The nymphs are naked and honey yellow in general color, with the wing pads and body margin sometimes darker.

Teneral adults are green and remain so for many days after emerging. Later they become yellowish green and apparently remain so during the summer. The dark brown coloration has been found only on specimens which survived the winter and were collected in the early spring. The overwintering adults apparently survive for only a short time after eggs are deposited.

Parasites. On April 7, 1943 eight parasitized *tenuata* nymphs were found on *Salix laevigata* at Colton, California. The adult parasites emerged during the period from April 18 to 24. They were determined by Mr. A. B. Gahan of the U. S. National Museum, to be a new and undescribed species of *Prionomitus* (Encyrtidae).

Psylla alaskensis Ashmead

Psylla alaskensis Ashmead 1904

Arytaina fuscata Caldwell 1938

Psylla alaskensis Tuthill 1943

Tuthill recorded this species from willow in Colorado and listed *Arytaina fuscata* Caldwell as a synonym of *alaskensis*. Caldwell's specimens originated in Manitoba.

New record. The writer has three females of what appear to be this species collected at the south end of Summit Lake, Alaska, August 12, 1947 by A. H. Storm.

Range. Alaska, Manitoba, Colorado.

Psylla latiforceps Tuthill

Fig. 4, E

Psylla latiforceps Tuthill 1943

Tuthill collected teneral adults and nymphs, presumably of the same species, from willow in Colorado. In addition to the Colorado material, specimens from Redmond, Deschutes County, Oregon were designated as paratypes. I have examined Colorado paratypes provided by Dr. Tuthill and Oregon paratypes provided by Mr. J. Schuh. The Oregon specimens proved to be *Psylla nordica* Jensen, and not *latiforceps*.

Range. Colorado.

Psylla nordica Jensen, new species

Fig. 4, A-D

Color. General color brownish red. Cream-colored markings on dorsal surface similar to but less pronounced than on *yosemitensis*. Forewings clear, veins brown, pterostigma light brown.

Structure. Length to tip of folded wings 3.4-3.6 mm; length of forewing 3.0-3.2 mm, approximately $2\frac{1}{2}$ times as long as broad; width of head 0.77-0.85 mm; length of antennae 1.2 mm. **Head** (Fig. 4, D) deflexed at 45° angle or greater; vertex with 2 discal foveae, emarginate along median line and bulging forward in anterior portion. Genal processes 0.19 mm long, equal to length of vertex along median suture, conical, divergent but contiguous basally, bearing scattered long hairs. **Forewings** about two and one-half times as long as wide, broadly rounded distally; pterostigma large; a patch of small setae near distal margin midway between each pair of veins from Cu_2 to radial sector.

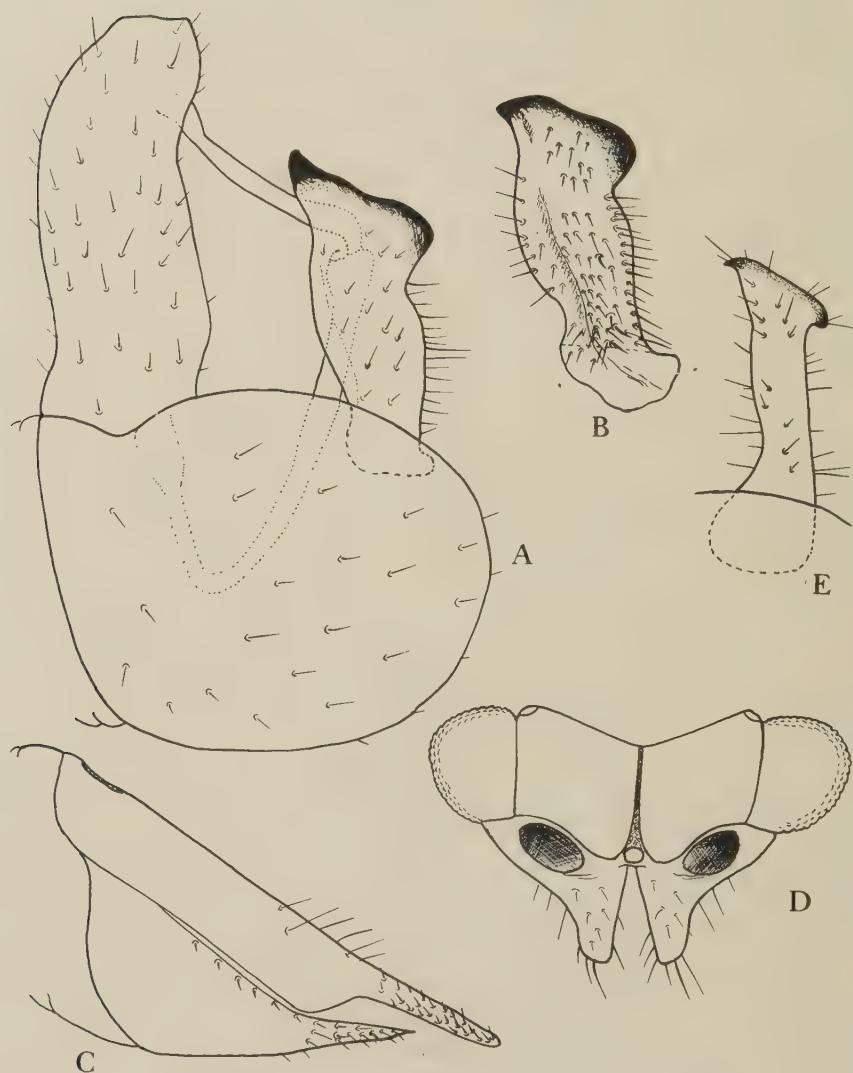


Fig. 4. *Psylla nordica* n. sp. A, male genitalia, lateral view; B, mesal face of male forcep; C, female genitalia; D, head.

Psylla latiforceps Tuthill. E, outer surface of male forcep.

Genitalia. Male. (Fig. 4, A, B). Proctiger 0.425 mm long, straight; cephalic margin convex except for basal concavity. Forceps 0.26 mm long above ventral genital valve; in lateral view broad, 0.09 mm at middle and 0.15 mm at apex; bowed slightly caudad in proximal half, then curved cephalad, sub-apically terminating in a broad, black-margined apex; posterior angle of apex broadly rounded, anterior portion produced cephalad as a less bluntly rounded triangular apex. Anterior margin in basal half excavated on mesal surface

leaving outer face produced anteriorly as a semi-transparent flange. Setae scattered sparsely over outer surface; inner surface more thickly beset with heavier setae. **Female.** (Fig. 4, *C*). Genital segment sub-equal to rest of normally distended abdomen. Dorsal valve straight, tapering to a bluntly rounded apex. Ventral valve shorter than dorsal, acute.

Host. Probably willow.

Type locality. Oroville, Okanogan County, Washington.

Holotype male, **allotype** female, one male and 33 female paratypes from willow, Oroville, Washington, October 29, 1941 (D. D. Jensen). Additional paratypes as follows: two males from pear, Methow Valley, Okanogan County, Washington, November 7, 1940 (Norton Wilson); one male from Douglas County, Washington, April 21, 1944 (pear psylla survey collection). Holotype, allotype and paratypes will be deposited in the U. S. National Museum. One male paratype and one female paratype will be placed in the California Academy of Sciences, one male and one female in the collection of Norton Wilson, and two paratype males and female paratypes will be placed in the writer's collection. Two additional males, not designated as paratypes, were collected at Redmond, Deschutes County, Oregon, June 1, 1939 by Schuh and Gray. These two specimens were listed by Tuthill as paratypes of *Psylla latiforceps* Tuthill and are deposited in the California Academy of Sciences.

Range. Washington, Oregon.

Taxonomy. This species is distinct from *latiforceps* as is evident by a comparison of the male forceps of the two species. In *latiforceps* the forceps are much more slender and differ in shape from *nordica*. The illustration of the clasper of *latiforceps* (Fig. 4, *E*) was made from a paratype in the original type series from Creede, Colorado and this specimen was presented to the writer by Dr. Tuthill.

Psylla latiforceps, as now defined, is known only from Colorado. *Psylla nordica* is known only from Washington and Oregon.

Psylla fibulata Crawford

Psylla fibulata Crawford 1914

This species was described from Colorado. Tuthill (1943) collected it abundantly on willow in Colorado. The presence of nymphs and teneral adults on the same willows provides strong evidence that willow is the host plant.

Klyver (1932) reported *fibulata* from Idaho.

Strickland (1938) recorded *fibulata* or a related species from Edmonton, Alberta.

New record. One male from willow, Meacham, Umatilla County, Oregon, July 10, 1943 (D.D.J.).

Range. Colorado, Idaho, Oregon; Alberta (?).

SPECIES PROBABLY BREEDING ON WILLOW

The following species are included in this paper because it is believed that their host plants will prove to be species of *Salix*. The evidence for this belief is derived from the relationship of some of these species to others known to breed on willow and from the morphology and coloration they possess.

Psylla sinuata Crawford*Psylla sinuata* Crawford 1914

Crawford described *sinuata* from specimens collected in Colorado and Labrador. The species has also been recorded from Idaho (Klyver, 1932), Manitoba, Minnesota and Colorado (Tuthill, 1943) and from Alberta (Strickland, 1938). Tuthill reported it as being very abundant on willow near Creede, Colorado. Strickland listed white spruce, *Picea glauca*, as a host plant. However, the writer is of the opinion that *Salix* rather than *Picea* may prove to be the true host of *sinuata*. This is based on the following reasons: 1) *Psylla sinuata* is closely related to *fibulata* which apparently breeds on willow; 2) Tuthill found *sinuata* abundantly on willow in Colorado; 3) there is no other record in the literature of a psyllid nymph developing on conifers in North America.

Strickland had reported both nymphs and adults on small spruces growing under deciduous trees. However, he added, "They could not be found on spruces which grew in the open." Dr. Strickland has very kindly sent me specimens from Alberta and provided me with some of his field notes which he permits me to use. He states that adults were taken on laurel-leaved and broad-leaved native willows but not on narrow-leaved willow. The trees which shaded the small spruces on which nymphs and adults were taken consisted of aspens and narrow-leaved willows. The nymphs and adults collected from spruce were taken by sweeping. Only one or two specimens were found in the net but he found them more than once on different trees. It is possible that the nymphs and adults developed on willow and dropped onto the spruces growing beneath.

New record. Two adult males from willow, Fishing Bridge, Yellowstone National Park, Wyoming, July 25, 1948 (D.D.J.).

Range. Labrador, Manitoba, Alberta, Minnesota, Colorado, Wyoming, Idaho.

Psylla yosemitensis Jensen, new species

Fig. 5, A-D

Color. Reddish brown to dark brown in general color. Vertex orange except for black discal foveae, light areas anteriorly, along median line and along posterior margin from median line half way to lateral ocelli; genal processes light brown to dark, especially apically. Antennae black to brown, becoming lighter in proximal portion. Thoracic dorsum predominantly dark brown to dark orange, broken by cream-colored markings as follows: posterior half of pronotum, lateral and caudal margins of prescutum, and four longitudinal stripes on scutum. Forewings clear, veins brown, pterostigma light brown. Abdomen and venter black.

Structure. Length to tip of folded wings 3.3 mm; length of forewing 2.7-3.0 mm; width of head 0.7-0.8 mm; length of antennae 1.0 mm. **Head** (Fig. 5, A) deflexed at 45° angle or greater; vertex with 2 deep discal foveae near posterior margin and median suture, anterior portion bulging forward strongly emarginate along median line. **Genal processes** 0.17-0.2 mm long, equal to length of vertex along median line, conical in form, contiguous bas-

ally, diverging distally to subacute apices; pubescence sparse, white, moderately long. **Forewings** (Fig. 5, D) about two and one-half times as long as wide; broadly rounded distally; pterostigma large; a patch of small setae near the wing margin between the distal ends of the veins; inconspicuous tiny setae scattered over much of the wing membrane.

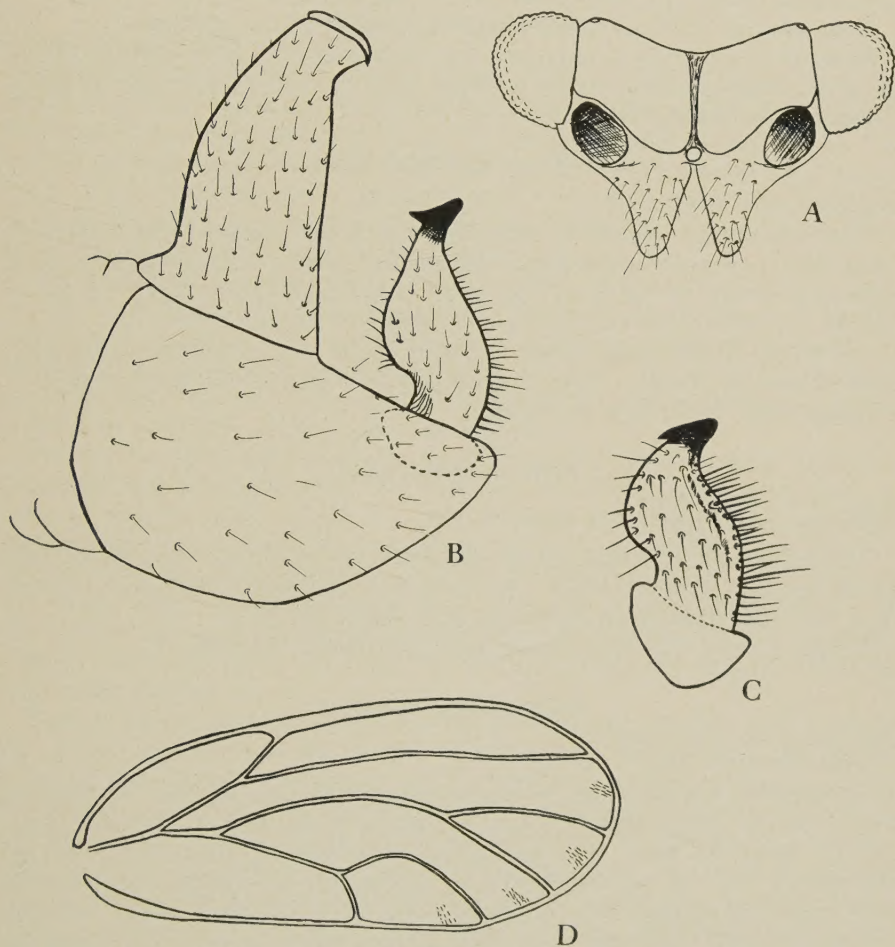


Fig. 5. *Psylla yosemitensis* n. sp. A, head; B, male genitalia in lateral view; C, inner face of male forcep, caudo-lateral view; D, forewing.

Genitalia. Male. (Fig. 5, B, C). Proctiger 0.34 mm long. Forceps 0.2 mm long above subgenital plate; in lateral view broadest near middle, becoming narrower distally and terminating in a black beak-like apex; forceps nearly straight in basal half, bending mesad at about a 45° angle distally; outer surface sparsely beset with setae, inner surface with many conspicuous setae, especially along caudal margin.

Holotype male, and one male paratype collected at Gaylor Lakes, Yosemite National Park, California, July 8, 1946 by R. L. Usinger. Two additional male

paratypes collected at Tuolumne Meadows, Yosemite Park, California, August 9, 1946 by T. O. Thatcher. One additional male, not designated as a paratype, from Carson City, Nevada, June 25, 1929 (E. P. Van Duzee). The female is unknown.

Holotype and one paratype deposited on loan in the California Academy of Sciences. Two paratypes in the writer's collection.

Type locality. Gaylor Lakes, Yosemite National Park, California.

Host. The host plant is unknown, but similarity of *yosemitensis* to others living on willow make it highly probable that its host will prove to be *Salix*.

Range. California, Nevada.

Psylla quadrilineata Fitch

Psylla quadrilineata Fitch 1851

The host of this species is unknown, but in its physical characteristics *quadrilineata* resembles the willow-inhabiting species sufficiently to place it with those which probably will be found to breed on willow. Both Crawford (1914) and Tuthill (1943) refer to its similarity to *americana*.

Crawford (1914) listed *Psylla gillettei* Patch as a synonym of *quadrilineata*. However, Tuthill (1943) considered *gillettei* a synonym of *ribesiae*.

Range. New York, New Hampshire.

Psylla hamata Tuthill

Psylla uncata Tuthill 1943

Psylla hamata Tuthill 1944 (new name)

According to Tuthill this species was erected to include the specimens from Banff Springs, Alberta, which Crawford had included in the species *americana*. The host plant is unknown but is probably *Salix*.

Range. Known only from Banff Springs, Alberta, Canada.

Psylla arctica (Walker)

Aphalara arctica Walker 1852

Psylla arctica Scott 1882

This species was described by Walker from three females from St. Martins Falls, Albany River, Hudson's Bay, deposited in the British Museum. Scott (1882), using the three type specimens in the British Museum, illustrated the species but did not redescribe it. Additional specimens, authentically determined as *arctica*, have not been taken since the type series. Schwarz (1900) reported three specimens from Alaska which he said were immature and "may possibly belong to *Psylla arctica* Walker . . ." Tuthill (1943) stated the species seems to belong in the *americana* complex. This affinity is suggested by Scott's illustrations and if true, the host plant will probably be *Salix*.

Range. Known only from Hudson's Bay.

Psylla propria Tuthill

Psylla propria Tuthill 1943

The host plant of this species is not known, but on the basis of its form and coloration, it is probably a willow-inhabiting species. However, it departs widely from the other species of the group in the form of the male genitalia.

The single host record cited by Tuthill was "*C. repand*" from which a single specimen was taken at Milford, Beaver County, Utah. This apparently refers to the roadside cruciferous weed, *Cheirinia* (*Erysimum*) *repandum*, known as wallflower. The presence of the psyllid on the plant was probably accidental.

Range. Colorado, Utah.

Psylla confusa Tuthill

Psylla confusa Tuthill 1943

Tuthill referred to the similarity of this species to *curta* which is known to breed on willow. *Psylla confusa* resembles the other willow psyllids in general form although a male paratype from Hoytsville, Summit County, Utah, has longer genal processes than normally occur on the willow psyllids. The dorsal valve of the female genitalia resembles that of *alba* and *tenuata*, being somewhat intermediate between the two. The male forceps are sufficiently distinct to set the species apart from *curta* and related forms.

The specimens which Klyver (1931a) reported as *breviata* are in the entomology collection of Stanford University. They have been examined by the writer and proved to be *Psylla confusa*. They were collected primarily in southern Utah and southern Nevada by E. W. Davis who collected the type material at St. George, Utah, which Tuthill used in erecting the species. These collections are listed below under new records.

Among the specimens available are four males. Three of these have the proctiger and forceps exactly like those on the single paratype of *confusa* from Hoytsville, Utah, which is available to the writer. In these specimens the proctiger is not markedly hooked caudad apically and the forceps terminate in black and slender but short apices. The fourth male, one of two from St. George, Utah, has the proctiger bent caudad as illustrated by Tuthill and the forceps terminate in somewhat more elongate, slender apices than is the case on the other males. This may be within the normal range of variation within the species.

Tuthill interpreted the collections of adults from creosote bush, *Larrea* (*Covillea*) *tridentata* at St. George, Washington County, Utah; Riverside, Nevada; and Littlefield, Mohave County, Arizona, as evidence that this plant is the host of *confusa*. The writer believes it is more probable that the specimens in question developed on willow and moved to creosote bushes as adults. This plant is among the most common green shrubs in this desert region and frequently harbors species which breed on other plants. For example, *Paratrioza cockerelli* (Sule) occurs on *Larrea* frequently, especially during the winter months. Moreover, among the paratypes of *confusa* is a series of 9 adults collected at Hoytsville, Summit County, Utah. This locality is over 200 miles from the nearest creosote bush. Among the other plants harboring *confusa* are *Pluchea sericea*, *Chrysothamnus speciosus*, *Salsola pestifer*, *Bassia hyssopifolia*, and *Mentzelia multiflora*.

Previous records. Hoytsville and St. George, Utah; Littlefield, Arizona; Riverside, Nevada.

New records. Two males from *Chrysothamnus speciosus*, St. George, Utah, May 1, 1930 (E. W. Davis); two males from *Larrea tridentata*, St. George, Utah, May 1, 1930 (Davis); one female from *Salsola pestifer*, St. George,

Utah, May 17, 1930 (Davis); one female from *Pluchea sericea* at Overton, Clark County, Nevada, April 30, 1930, and one female from the same host at Glendale, Nevada, May 3, 1930 (Davis). One male from *Mentzelia multiflora* Gray, Potholes, Imperial County, California, April 7, 1923 (E. P. Van Duzee).

Range. Utah, Nevada, Arizona, California.

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